USDA Natural Resources Conservation Service

Ecological site R243XY403AK
Arctic dwarf scrub gravelly slopes

Last updated: 5/29/2025
Accessed: 02/08/2026

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 243X–Western Brooks Range Mountains, Foothills, and Valleys

Boundaries and important features:

The Western Brooks Range Mountains, Foothills, and Valleys MLRA (MLRA 243X) encompasses the southern slopes of the De Long Mountains, the Baird Mountains, the Noatak River drainage, and the lower Kobuk River drainage. The southern limit of the area includes the western Lockwood Hills, Sheklukshuk and Waring Mountains, and Kiana and Igichuk Hills. MLRA 243 makes up 22,705 square miles. This MLRA shares boundaries with MLRAs 242X, 244X, and 245X. MLRA 242X (Northern Seward Peninsula-Selawik Lowlands) has nearly level to rolling plains, river deltas, and extended mountain footslopes. MLRA 244X (Northern Brooks Range Mountains) has steep, rugged, high mountains and narrow valleys. MLRA 245X (Arctic Foothills) has broad, rounded hills and nearly level uplands at the base of the Brooks Range. MLRA 243X shares a less apparent boundary with MLRAs 233 (Upper Kobuk and Koyukuk Hills and Valleys) and 234X (Interior Brooks Range Mountains), where a continental subarctic climate prevails.

Kobuk Valley National Park is located in the south-central portion of MLRA 243X, along the Kobuk River. Kobuk Valley National Park has an area of around 1.75 million acres and was designated to preserve the 100 ft high Great Kobuk Sand Dunes and the surrounding area which includes the Onion Portage caribou migration route. The Noatak National Preserve is located in the north-central portion of the MLRA, along the Noatak River corridor. The Noatak River is the nation’s largest unaltered river basin, and the preserve is around 6.5 million acres. 5.7 million acres of the preserve are designated as wilderness. The Noatak River is also a designated National Wild and Scenic River.

The Red Dog Mine is located in the northwestern portion of the MLRA. The Red Dog Mine is the world's largest producer of zinc and has the world's largest zinc reserves. The mine is the primary economic driver of the Northwest Arctic Borough. The Northwest Arctic Borough was formed in 1986 on the economic basis of taxing the mine.

Geology:

The entire area was glaciated during the Early and Middle Pleistocene, except for possibly small portions of the Baird Mountains. By the Late Pleistocene, glaciers had retreated from most of the area, except for the central, upper-elevation portions of the De Long Mountains in the northern part of the MLRA. The valley of the upper Noatak River was likely covered by extensive proglacial lakes during parts of the Pleistocene Epoch. In the mountains, glacial deposits have eroded away or been buried by mountain colluvium and alluvium, which accumulated during the Holocene Epoch across about 60 percent of the present landscape.

Glacial moraines, drift, and outwash deposits are extensive on the lower mountain slopes and in valleys at the mid and lower elevations. These deposits cover about 18 percent of the MLRA. Flood plains, stream terraces, and alluvial fans have recent and Pleistocene fluvial deposits. The underlying bedrock geology consists almost entirely of stratified sedimentary rocks of Paleozoic and Precambrian age and, in some cases, Cretaceous age.

This area is in the zone of continuous permafrost. In the mountains, permafrost is most evident in unconsolidated materials. In the valleys, thick layers of permafrost occur in both fine textured and coarse textured materials. Depth to the base of the permafrost layer may be 1,000 feet (305 meters) or more. In close proximity to water bodies, it may be 600 feet (185 meters) or more. Periglacial features, such as pingos, thermokarst pits, thaw lakes, solifluction lobes, and high- and low-center polygons, are common on-stream terraces, on the lower mountain slopes, and in swales on foothills.

Soils:

The dominant soil orders in this MLRA are Gelisols, Entisols, Inceptisols, and Mollisols. The soils in the area have a gelic soil temperature regime and an aquic or udic soil moisture regime. The Gelisols are shallow or moderately deep to permafrost, occur on fine to gravelly textured sediments, and are very poorly to moderately well drained. Common Gelisol suborders are Histels, Orthels, and Turbels. The Histels have thick accumulations of surface organic material and occur in depressions, lake margins, and shallow basins. The Orthels and Turbels have comparably thinner surface organic material with the Turbels being cryoturbated. These widespread soils occur on slopes of mountains, hills, and plains across the MLRA. Inceptisols (suborder Gelepts), Mollisols (suborder Gelolls), and Entisols (suborder Gelents) occur on upper mountain slopes and ridges formed in loamy to stony colluvium and residuum. These soils are shallow to deep and are generally

well drained. Entisols (suborder Cryofluvents) on flood plains formed in stratified loamy, sandy, and gravelly alluvium and are somewhat poorly to well drained.

Vegetation Dynamics:

The mountain slopes and ridges in this area generally support dwarf scrub dominated by Dryas, ericaceous shrubs including crowberry, and dwarf willow. Lichens and scattered herbs dominate the ground layer on shallow, rocky soils and exposed sites. There are extensive areas of bare soil and bedrock. On the more mesic sites, sedges, forbs, and mosses cover most of the surface. Areas at the lower elevations and areas of the deeper soils on nearly level uplands, terraces, and basins generally support low willow and ericaceous shrub scrub and mesic graminoid herbaceous communities, commonly with extensive areas of tussock-forming sedges. Saturated sites support wet sedge meadows and wet sedge-moss meadows. Flood plains support a mixture of tall and low scrub dominated by various willows, shrub birch, and alder.

Climate:

Short, generally cool summers and long, very cold winters characterize the continental arctic climate of the area. The average annual precipitation ranges from about 10 to 15 inches (255 to 380 millimeters) at the lower elevations in the western part of this MLRA and along the central Noatak River and from about 20 to 40 inches (510 to 1,015 millimeters) in the mountains. The average annual snowfall is about 35 to 100 inches (90 to 255 centimeters). The average annual temperature ranges from about 8 to 16 degrees F (-13 to -9 degrees C). Snow and freezing temperatures can occur in any month of the year, particularly at the higher elevations.

LRU notes

This area supports two life zones defined by the physiological limits of plant communities along an elevational gradient: arctic lowlands and alpine. In this MLRA, the arctic lowland life zone typically occurs below 1000 feet elevation on average and is the elevational band where lowland vegetation dominates. For this MLRA, certain vascular plant species are common in the lowlands and much less common in the alpine (i.e. Betula nana, Salix pulchra, Ledum palustre). Above the arctic lowlands band of elevation, alpine vegetation dominates. For this MLRA, certain vascular plant and lichen species are common in the alpine and much less common in the lowlands (i.e. Dryas octopetala, Saxifraga oppositifolia, *Empetrum nigrum*). The transition between arctic and alpine vegetation can occur within a range of elevations, and is highly dependent on latitude, slope, aspect, and shading from adjacent mountains.

Classification relationships

Landfire Biophysical Settings – 6716902 – Alaska Arctic Dwarf-Shrubland-Infrequent Fire (Landfire 2009)

Viereck Communities:

Crowberry dwarf shrub tundra – II.D.2.C (Viereck et al. 1992)
Cassiope dwarf shrub tundra - II.D.2.e (Viereck et al. 1992)

Ecological site concept

• Occurs on the tops and flanks of rugged mountains.
• Associated with the alpine. Elevation ranges between 1000 and 5400 feet. Slopes are gently sloping to steep and occur on all aspects.
• Soils are derived from silty loess over gravelly colluvium. The colluvium is derived from acidic bedrock.
• Soils are moderately deep to very deep, with soil depth controlled by bedrock contact. These gravelly soils do not have permafrost.
• These dry soils are considered well drained and do not pond or flood.
• Soils range from very strongly acidic to slightly acidic.
• The reference plant community is characterized as either crowberry or Cassiope dwarf shrub tundra (Viereck et al., 1992). Wildland fire results in one additional post-fire plant community.

Associated sites

R243XY302AK	**Alpine scrub gravelly frozen slopes** Occurs downslope on wet and frozen soils.
R243XY301AK	**Alpine scrub gravelly swales** Occurs downslope on swales with shrubby vegetation.

Similar sites

R243XY404AK	**Alpine dwarf scrub gravelly limestone slopes** Site 404 has alkaline soils resulting in different kinds and amounts of vegetation.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Empetrum nigrum* (2) *Cassiope tetragona*
Herbaceous	(1) *Anthoxanthum monticola ssp. alpinum* (2) *Cladina*

Physiographic features

This alpine dwarf scrub ecological site (R243XY403AK) occurs on the tops and flanks of rugged mountains. Representative elevation ranges from 1000 to 5400 feet but this ecological site occurs at lower elevations on exposed, windswept positions. Slopes range from gently sloping to steep and show no preference for north-facing or south-facing aspects. Flooding and ponding do not occur. These dry soils do not have a seasonal water table in the soil profile. There is low to medium amounts of runoff to adjacent, downslope ecological sites.

Table 2. Representative physiographic features

Geomorphic position, mountains	(1) Mountaintop (2) Mountainflank
Hillslope profile	(1) Summit (2) Shoulder (3) Backslope
Landforms	(1) Mountains > Mountain slope
Runoff class	Low to medium
Flooding frequency	None
Ponding frequency	None
Elevation	305–1,646 m
Slope	15–60%
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	15–1,928 m
Slope	Not specified

Climatic features

MLRA 243X is characterized by an arctic continental climate having short, warm summers and long, cold, dark winters. The average annual mean temperature is 20.1 degrees Fahrenheit. The warmest months span June through August, with normal maximum temperature ranging from 57 to 61 degrees Fahrenheit. The coldest months are December through February, with normal minimum temperature ranging from -15 to -10 degrees Fahrenheit. This MLRA receives high annual precipitation with the summer months being the wettest. Average annual precipitation ranges from 9 to 32 inches. Approximately 40

percent of the annual precipitation occurs during the months of July through September.

Snow persists in the alpine and arctic lowland life zones throughout much of the year. A lack of trees and tall shrubs also means that this site is subject to strong winds, further exacerbating cold temperatures. This ecological site has a much shorter growing season than sites in lower elevation areas and the growing season is significantly colder for associated vegetation.

Table 4. Representative climatic features

Frost-free period (characteristic range)	55-85 days
Freeze-free period (characteristic range)	40-70 days
Precipitation total (characteristic range)	356-660 mm
Frost-free period (actual range)	45-90 days
Freeze-free period (actual range)	30-75 days
Precipitation total (actual range)	229-813 mm
Frost-free period (average)	69 days
Freeze-free period (average)	54 days
Precipitation total (average)	508 mm

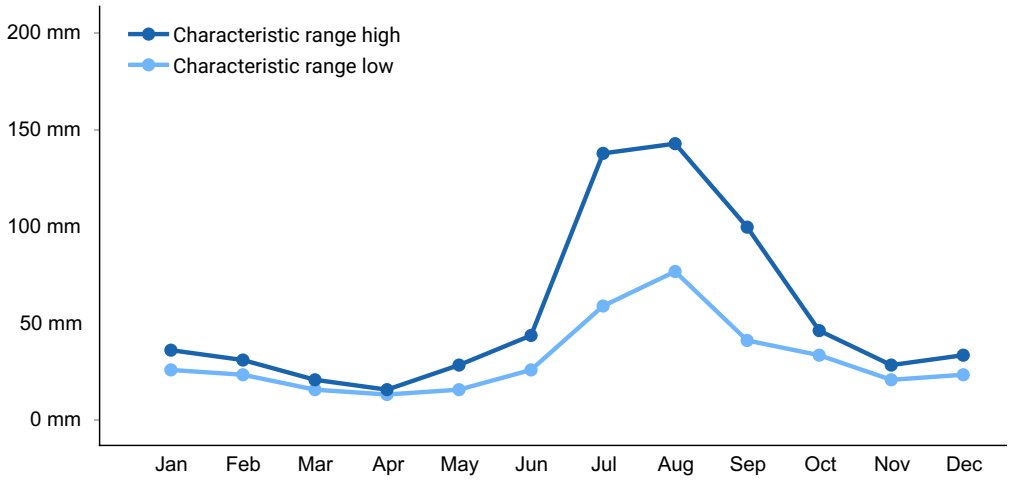


Figure 1. Monthly precipitation range

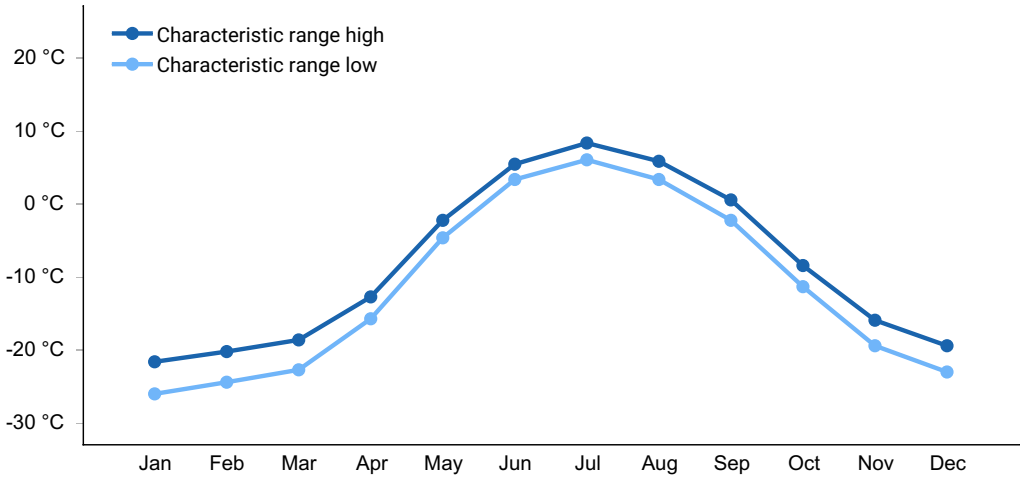


Figure 2. Monthly minimum temperature range

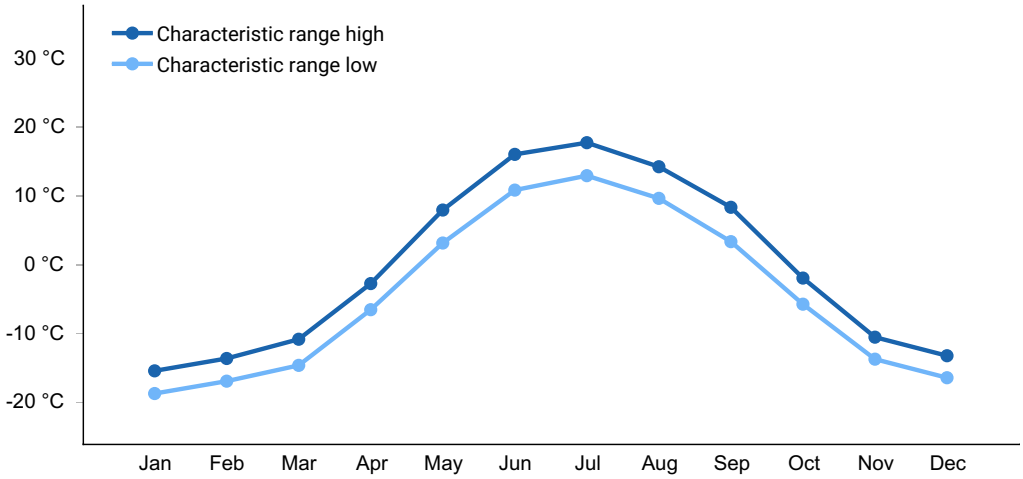


Figure 3. Monthly maximum temperature range

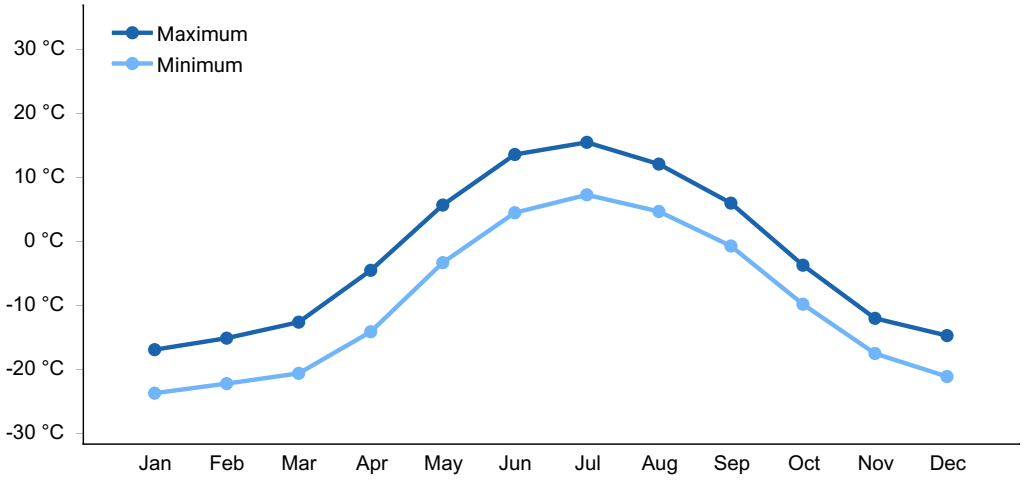


Figure 4. Monthly average minimum and maximum temperature

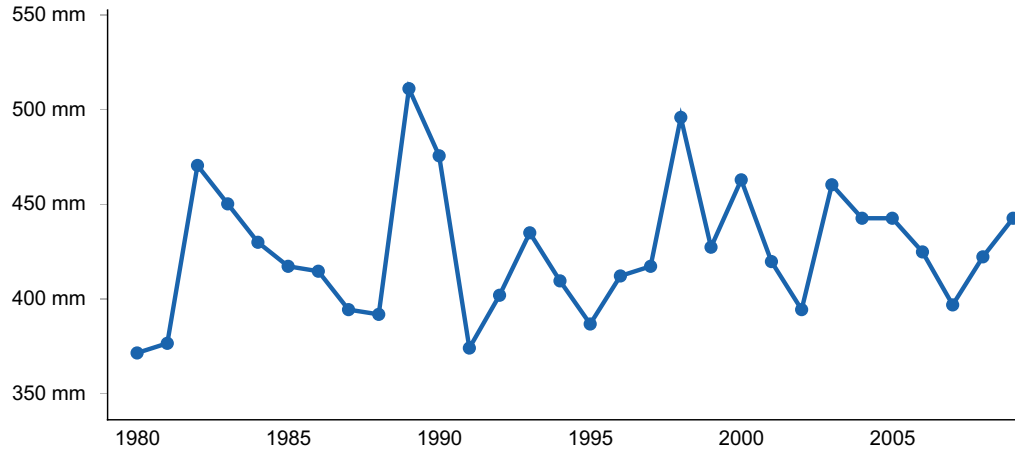


Figure 5. Annual precipitation pattern

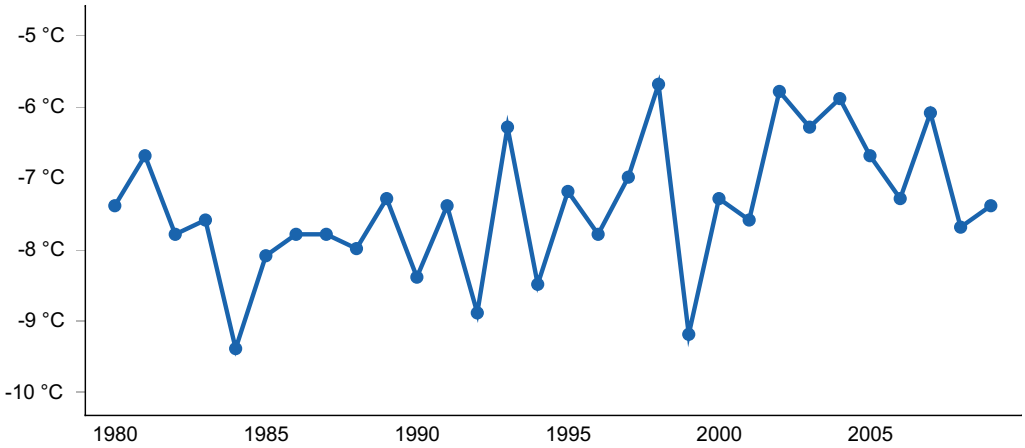


Figure 6. Annual average temperature pattern

Influencing water features

Due to its landscape position, this site is neither associated with or influenced by streams or wetlands. Precipitation and throughflow are the main source of water for this ecological site. Surface runoff and throughflow contribute some water to downslope ecological sites.

Wetland description

not a wetland

Soil features

• Soils formed in loess over gravelly colluvium. The colluvium is derived from schist, igneous rock, and other acidic bedrock.
• Rock fragments on the soil surface range between 0 and 35 percent cover.
• Capped with up to one inch of organic material.
• The surface mineral horizons are silt loams or channery silt loams with the silty material being derived from loess or silty colluvium. Where present, the silt loam surface layer is

thin.
• These gravelly soils have subsurface rock fragments ranging between 30 and 75 percent of the soil profile by volume.
• Soils are moderately deep to deep, with soil depth controlled by bedrock contact (between 34 and 60 inches).
• Soil restrictions include strong contrasting textural stratification (between 2 and 11 inches) and bedrock (between 34 and 60 inches). The strong contrasting textural stratification does not perch water or impact the growth of vegetation. Permafrost does not occur in the soil profile.
• Soils range from very strongly acidic to slightly acidic.
• These dry soils are considered well drained.

Table 5. Representative soil features

Parent material	(1) Eolian deposits (2) Colluvium–schist (3) Colluvium–igneous rock (4) Colluvium
Surface texture	(1) Channery silt loam (2) Silt loam
Family particle size	(1) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately rapid
Depth to restrictive layer	5–152 cm
Soil depth	86–152 cm
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0%
Available water capacity (25.4-101.6cm)	3.3–10.41 cm
Calcium carbonate equivalent (25.4-101.6cm)	0%
Clay content (0-50.8cm)	10–15%
Electrical conductivity (25.4-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (25.4-101.6cm)	0
Soil reaction (1:1 water) (25.4-101.6cm)	5–6.2

Subsurface fragment volume <=3" (0-152.4cm)	10–25%
Subsurface fragment volume >3" (0-152.4cm)	20–50%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	5–178 cm
Soil depth	51–178 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	0–15%
Available water capacity (25.4-101.6cm)	Not specified
Calcium carbonate equivalent (25.4-101.6cm)	Not specified
Clay content (0-50.8cm)	Not specified
Electrical conductivity (25.4-101.6cm)	Not specified
Sodium adsorption ratio (25.4-101.6cm)	Not specified
Soil reaction (1:1 water) (25.4-101.6cm)	Not specified
Subsurface fragment volume <=3" (0-152.4cm)	10–35%
Subsurface fragment volume >3" (0-152.4cm)	20–65%

Ecological dynamics

The Western Brooks Range MLRA (MLRA 243X) occurs in the arctic biome and this ecological site is exposed to a variety of harsh environmental conditions. This MLRA has cool, short summers and long cold winters. Limited warmth during the short summer months inhibits trees from occurring, and the expansive tundra is composed of a mosaic of low growing shrubs, sedges, moss, and lichen. Sites with greater than 25 percent lichen cover tend to be exposed to the wind and accumulate little winter snow (Viereck et al. 1992).

Fire patterns in the MLRA

Within this MLRA, fire is considered a natural and common event that typically is unmanaged. Fire suppression is limited, and generally occurs in the southern part of the MLRA and along the Kobuk and Noatak River valleys. Most fires are caused by lightning strikes.

Reported fire history in this MLRA spans 1946 to 2021 and there were 262 fires totaling 1.4 million acres burned. Of those 262 fires, 154 were between 1 and 1000 acres, with the largest being approximately 210,000 acres.

Tundra fire regimes, like the ones found in MLRA 243X, are poorly understood and rapidly changing. Tundra burning impacts vegetation composition, nutrient cycling, and permafrost dynamics (Racine et al 1987, 2004). Increasing evidence suggests that Arctic warming is affecting tundra fire regimes. In 2010, 37 fires burned 106,000 acres in the Noatak National Preserve, located within MLRA 243X. This was the largest number of fires that have occurred in the area since record keeping began in 1950 (Jones et al 2009).

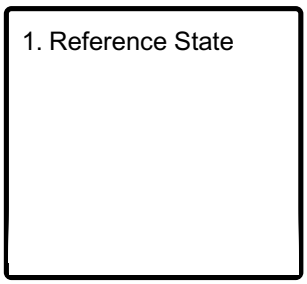
Changes in fuel characteristics associated with increased shrub growth and/or density due to warming over the past several decades (Racine et al 1987, 2004) may have contributed to the intensity of recent burns. There is also evidence to suggest that Betula shrubs have contributed to high levels of tundra burning in the past. This suggestion, in combination with studies documenting increased birch (Betula spp) abundance in early stage post-fire plant communities raises the possibility of a positive feedback loop between increased shrub density and increased tundra burning (Joly et al 2010).

Fire Dynamics for this ecological site

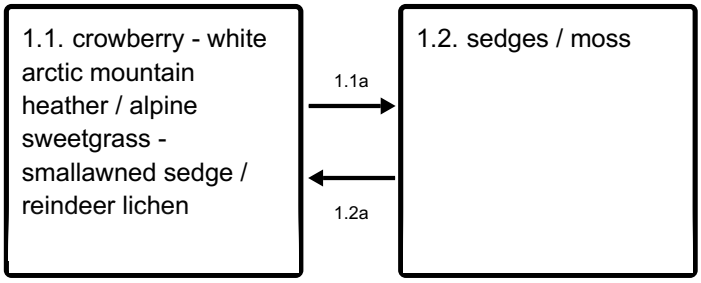
Crowberry, *Empetrum nigrum*, generally occurs in communities with long fire intervals or in plant communities that lack the dry fuel to sustain a fire. Dwarfed growth form and small stems make crowberry liable to top-kill by fire (FEIS 2024). Belowground roots and stems are also vulnerable to fire damage because most of them are located near the soil surface. Post-fire re-establishment of crowberry and other common shrub species associated with this ecological site occurs from surviving individuals, on-site surviving root crowns, off-site colonizers, or seeds transported by animals or abiotic vectors (FEIS 2024). Vegetative regeneration is slow and pre-fire densities may not be reached for 20 to 30 years after a fire event (Landfire 2009).

State and transition model

Ecosystem states



State 1 submodel, plant communities



1.1a - Disturbance by Fire

1.2a - Time without fire.

State 1
Reference State

Depending on dominance, the reference plant community is characterized as either crowberry dwarf shrub tundra or Cassiope dwarf shrub tundra (Viereck et al. 1992). There are two plant communities within the reference state related to fire. All plant communities associated with the site have limited data, so the state-and-transition model is provisional.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- alpine sweetgrass (*Anthoxanthum monticola ssp. alpinum*), grass
- smallawned sedge (*Carex microchaeta*), grass
- reindeer lichen (*Cladina*), other herbaceous

Community 1.1
crowberry - white arctic mountain heather / alpine sweetgrass - smallawned sedge / reindeer lichen

This community is characterized as dwarf shrub tundra (Viereck et al. 1992). Common plants include crowberry, white arctic mountain heather, bog blueberry, various willow, alpine bearberry, and an assortment of other shrubs, forbs, graminoids, and lichens. Vegetative strata with the highest cover are dwarf shrubs with lichen becoming more important as elevation or exposure increases.

Dominant plant species

- black crowberry (*Empetrum nigrum*), shrub
- white arctic mountain heather (*Cassiope tetragona*), shrub
- bog blueberry (*Vaccinium uliginosum*), shrub
- netleaf willow (*Salix reticulata*), shrub
- arctic willow (*Salix arctica*), shrub
- least willow (*Salix rotundifolia*), shrub
- alpine bearberry (*Arctostaphylos alpina*), shrub
- eightpetal mountain-avens (*Dryas octopetala ssp. octopetala*), shrub
- entireleaf mountain-avens (*Dryas integrifolia*), shrub
- smallawned sedge (*Carex microchaeta*), grass
- alpine sweetgrass (*Anthoxanthum monticola ssp. alpinum*), grass
- Altai fescue (*Festuca altaica*), grass
- Bigelow's sedge (*Carex bigelowii*), grass
- greygreen reindeer lichen (*Cladina rangiferina*), other herbaceous
- star reindeer lichen (*Cladina stellaris*), other herbaceous
- witch's hair lichen (*Alectoria nigricans*), other herbaceous
- whiteworm lichen (*Thamnolia vermicularis*), other herbaceous
- snow lichen (*Stereocaulon*), other herbaceous
- Richardson's brookfoam (*Boykinia richardsonii*), other herbaceous
- glacier avens (*Geum glaciale*), other herbaceous
- woolly lousewort (*Pedicularis lanata*), other herbaceous
- alpine pussytoes (*Antennaria alpina*), other herbaceous

Community 1.2
sedges / moss

This plant community occurs immediately post-fire. The site is dominated by weedy bryophytes and sedges (Landfire 2009).

Dominant plant species

- smallawned sedge (*Carex microchaeta*), shrub
- Bigelow's sedge (*Carex bigelowii*), shrub
- polytrichum moss (*Polytrichum*), other herbaceous
- ceratodon moss (*Ceratodon purpureus*), other herbaceous
- (*Marchantia polymorpha*), other herbaceous

Table 7. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0-5%
Forb foliar cover	0%

Non-vascular plants	0-5%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	95-100%
Water	0%
Bare ground	95-100%

Pathway 1.1a
Community 1.1 to 1.2

Disturbance by fire. This community phase will persist for 0-19 years (Landfire 2009). The mean fire return interval is every 1,000 years, and will reset the age of this class (Landfire 2009).

Pathway 1.2a
Community 1.2 to 1.1

Time without fire. Dwarf shrubs recapture the site within 24 years. Low shrubs can occur but with <25% cover. Vaccinium, Salix, Arctostaphylos and Ledum spp. tend to recover more quickly than *Empetrum nigrum* which has shallow rhizomes that are more susceptible to moderate and high severity fire. This class will persist in the absence of disturbance. The mean fire return interval is 1,000 years, and will cause a transition to an early stage arctic dwarf shrubland community.

Additional community tables

Animal community

Mammals common to MLRA 243 include brown bear, caribou, moose, musk ox, black bear, wolf, red fox, and rodents. Many species of migratory waterfowl and shore birds nest in the abundant ponds and wetlands. Raptors include gyrfalcon, peregrine falcon, golden eagle, hawks, and owls. Arctic char and Arctic grayling are in most of the rivers. Lake trout and northern pike are common in many lakes.

Hydrological functions

not available

Recreational uses

This remote area of Alaska is mostly undeveloped wildland and is sparsely populated. The area provides excellent opportunities for hunting and other kinds of wildland recreation. Most visitors are served by air taxi, guiding, and outfitting companies operating out of the major Alaska communities. Most of the communities are along the major rivers or lakes or on the coast. Kobuk Valley National Park is located within the Western Brooks Range MLRA. Visitors to Kobuk Valley NP typically fly in and camp / backpack in the park (USDA Agriculture Handbook 296).

Local residents use this area primarily for subsistence hunting, fishing, and gathering. In the Noatak Valley, many families leave their homes in villages in the spring and spend the summers at subsistence camps gathering salmon, caribou, and various wild greens and berries on the tundra.

Wood products

not available

Other products

not available

Other information

not available

Inventory data references

The vegetation modeled for this site has limited data and is considered provisional. The associated model was largely developed from NRCS staff with working knowledge of the area and literature review.

Other references

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

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Approved by	Blaine Spellman
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
